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CONTINUOUS GUM WORK:

A DESCRIPTION OF
NEW APPARATUS AND METHODS
FOR MANIPULATING

CONTINUOUS GUM

AND

PORCELAIN CROWNS.

BY

J. H. GARTRELL.

London:
THE DENTAL ENGINEERING COMPANY,
106, Great Portland Street, W.

1896.

INTRODUCTION.

In the following pages will be found not only new furnaces for continuous gum work and crowns and bridges, but essentially new processes for the construction of this work. Although continuous gum work has been known and fully described since Dr. John Allen introduced it about 1850, and is universally admired, yet it has been used only by a few of the profession, and the process, as described in the latest text books, is the same as I saw carried out by Mr. Close in 1863 in Dr. Allen's laboratory, and ever since at intervals of enthusiasm I have been a worker in continuous gum. With the old-fashioned furnaces and process enthusiasm was a necessity. I have, therefore, for some years been making efforts to get away from the beaten track, and modify the apparatus and process so as to bring it within the range of the ordinary work-room mechanic. This appears to be achieved, as my assistants and pupils and other members of the profession are working the method successfully, and there seems to be no reason why anyone who can do ordinary plate work should not succeed with continuous gum, by following the methods to be described.

CONTINUOUS GUM WORK.

IMPRESSIONS.

THE American authorities on Continuous Gum Work recommend plaster impressions, but those who have written on the subject in this country are more in favour of Stent's or similar compounds. As a rule plaster in my practice gives the better results. In cases where the gums are spongy and flabby from undue absorption of the alveolar process, and consequently difficult to scrape the plaster model to allow for the displacement when pressure is brought on the plate, impression compound answers better than plaster. A good way of testing this is to take impressions in both materials, then from models from each impression, strike up copper plates and try in the mouth. In the great majority of cases it will be found, if the model from a plaster impression has been properly scraped over the soft parts, and relieved with a thin layer of wax over the boney ridge in the centre of the palate, that the better fit is obtained. The conclusion is that as a general rule plaster is the better material for impressions, but in a few exceptional cases the compositions are the better, but this must be left to the judgment of the operator. Those who are inclined to give a sweeping assertion in favour of one material only had better try the plan mentioned of swaging copper trial plates, and trying them in the mouth.

METAL DIES.

Having obtained a good plaster model, the next step is making good dies. Zinc appears to be almost universally used, but I find an alloy of tin, antimony, copper, and zinc very much better. It is harder than zinc, is more easily melted, does not shrink any more than plaster expands, and is not injured by repeated use or overheating like zinc. It should, however, be prepared upon a larger scale than is practicable with members of the dental profession. It will consequently be prepared for the Dental Depôts to supply. Several leading members of the profession are using it, and think it far preferable to zinc.

THE PLATINUM PLATE.

All American authorities recommend soft or pure platinum for the plate; probably it is for the reason that hard platina as made in England does not appear to be known in America, where hard platinum is an alloy of platinum and iridium. In England what is called hard platinum, and used for dental purposes, is made of platinum alloyed with copper. This alloy for a dental plate is superior to pure platina or an alloy of platinum and iridium. Copper not only hardens platinum but toughens it so that it can be swaged without cracking better than pure platina, also a thinner plate may be made and have as great rigidity and strength as a thicker gauge in pure platina. The advantages are therefore a lighter and a tougher plate.

About three or four years ago I began to try hard platinum plate, No. 4 gauge perforated, and this has been used exclusively since whenever the plate is to be covered with body and gum enamel.

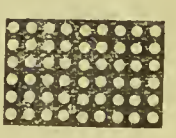

FIG. 1.

The illustration shews the size of the perforations, which lighten the plate considerably, and yet when the holes are

filled with baked body it appears as rigid as a solid plate. There are other advantages. It is unnecessary to solder a wire or swage up the margins of the plate to form a support for the body and gum enamel, since the body is securely attached to the plate by filling the perforations; for the same reason the trouble of roughing the lingual and buccal surfaces, as in solid plates, is avoided; also the margins may be cut away, after being worn, to relieve the gums from undue pressure without marring and weakening the pieces, as is the case when the boundary wire is cut through,—this applies especially to lower sets. These perforated plates are swaged in a similar manner to a solid plate, the same care taken not to tear it, and to anneal it thoroughly several times. After each swaging great care should be taken that no particles of metal from the dies adhere to the plate, and to be quite safe it should be pickled or dipped in nitric acid. If any of the base metal adheres to the plate it will discolour the platina by absorption when heated. A piece of rubber dam or linen should be placed between the lead counter and plate to assist its removal from the lead and to prevent the lead contaminating the plate, and towards the end a layer or two of brown paper placed between the plate and the lead counter. An alloy of four parts lead to one tin is better for the counter die than lead only, especially if the alloy mentioned for the die is used instead of zinc. If the plate should stick in the counter die it can usually be got out by striking the die on an anvil, or the die may be placed in a ladle, and when the lead and tin alloy is softened or near the fusing point the plate may be picked out with a pair of tweezers without danger of springing or bending it.

Another good plan to finally lay the plate is to make a counter of Stent's, or the compo. used for impressions, by softening it in hot water, placing it in an iron ring, and pressing the die into it, then cooling in cold water, and giving a final swage. The plate will stick in the compo. die, but the spring will be taken out, and the plate is easily removed by heat.

In making lower sets it is usually advisable for strength to double the plate back as far as the second bicuspids and

unite with solder. To make the plaster of non-perforated hard platina the process is similar to an ordinary gold plate, except that the platina should be heated as hot as possible between each swaging; annealing thoroughly is important to prevent cracking or tearing. When taking the impression it should be observed where will have to be the boundary line of the plate, so as not to interfere with the movements of the ligaments and soft parts; and when trying the swaged plate in the mouth this can be tested by lifting the lips and the tongue in lower cases, and should the plate be displaced the margins must be cut away. In a non-perforated plate this is necessary before soldering on the platina wire to form the rim, otherwise this rim may have to be cut away after the set is finished. If the plate is not to have the palatal portion covered with body and enamel, or only placed around the teeth like rubber attachments to a gold plate, then the plate should be made of non-perforated hard platina, No. 4 gauge, for most cases; and where the body covers the plate, burrs should be thrown up with a small round nose chisel to assist in uniting the body to the plate. The finishing die should be carefully retained in order to try the plate on it during the subsequent stages of construction.

MOUNTING THE TEETH.

The wax bite and plaster articulation is next obtained in the usual manner for a gold plate, and the teeth to be used selected. They may be continuous gum, or the ordinary pin teeth, flat or vulcanite, English or American; the heat in fusing the body and enamel does not go above the melting point of pure gold, a heat that English teeth will stand without injury. The teeth are mounted in a similar manner to a set on a gold plate for vulcanite attachments.

FITTING THE WIRE ATTACHMENT.

The set, being in position on the plaster model, is next invested with plaster, as shown in figure 2.

FIG. 2.

The model having been previously prepared with pits and soap solution, in order to remove the sections from the model after the plaster has set. For a full upper as shown, the investment is partly cut with a knife between the centrals so as to be removed in two parts, in which are held the teeth. A hard platina wire attachment is now soldered to the plate at intervals along the ridge, as shown in the illustration ; the size of the wire varies according to the strength required. The sizes of round wire, numbered 3, 4, and 5, supplied by

the Dental Depôts, will answer for nearly all cases; these correspond to the Nos. 12, 13, and 15 of the American Circular Standard Gauge. This wire attachment greatly strengthens the plate, and is used for this purpose as well as an attachment for soldering the pins of the teeth. To solder this wire a piece is taken about the length required to go around the ridge, one end is then caught with the solder, and the plaster section applied to the model, to see where to bend the loop to pass under the pins of the teeth, in order that after all the loops are made and soldered the pins may be bent down to touch the loops that the solder may unite them. In soldering the wire attachment, as shown in figure 2, the plate and wire are not invested, as the heat from the oxygen being very intense and local the plate may be held in the hand, to the surprise of anyone who has not seen an oxygen blow-pipe used before. It is a necessary precaution to smear the palatine surface with whiting and water where the loops join the plate, to prevent the solder running over it through the perforations and injuring the fit to the die.

THE SOLDER.

An alloy of 8½ parts pure gold to 1½ platina is used for the solder, with the object of having the wire attachment, pins of the teeth, etc., firmly united during the fusing of the body and enamel. To use pure gold for the solder, as described in the Text books, and a body and enamel that requires a higher heat than the melting point of gold, is to run the risk of the teeth being adrift and shifting their position during the firing of the body. Moreover, the body cannot unite to surfaces coated with melted gold. The alloy has also an advantage in not flowing so thin and fluid as pure gold, so that the surfaces to be united need not be in actual contact, as is a necessity with fine gold.

The wire attachment being soldered to the plate, the case is tried on the die to test its fit, and corrected if necessary.

SOLDERING THE TEETH.

The pins of the teeth have next to be soldered to the wire loops. To do this the plaster sections are replaced on the model, and the pins bent upon the loops, as shown by the section on the model in figure 2; wax cement is also melted around the pins to more effectually secure the teeth to the plate. The plaster investment is now cut away over the grinding surfaces and cutting edges, and the investment removed, leaving the teeth behind attached to the plate.

If the case is to be fitted with spiral springs, the platina tubes to carry the swivels are now placed in their proper position and held there by their inner ends being stuck in the wax. These tubes are made by wrapping a piece of platina plate around a steel wire, such as a knitting-needle, of the proper size. The case, including the tubes, are now invested in sand and plaster, as for soldering a set to a gold plate. When the investment has set, and the wax washed away, a piece of the solder mentioned is placed on each pin with borax, and on the inner ends of the tubes. The case is then heated red-hot over a gas-burner, or, preferably, by the petroleum-burner, as it is more powerful and effective than a Bunsen burner. To do this the continuous gum furnace is removed from the stand, and the soldering furnace, *F* shown in figure 5, is put in its place, having the opening in the side opposite the burner. The invested case is placed upon the furnace, the petroleum-burner is then set to work, as will be explained in the description of figure 5, with three or four pounds pressure, till the investment is quite dry, more pressure can then be put on the oil, when the case will quickly be heated red-hot. The furnace is then taken by the handle and carried to the bench, and the soldering done with the oxygen blow-pipe and coal-gas. A full set, as shown in figure 2, can be soldered in one minute, and there is no danger of injuring the teeth if the grinding surfaces and cutting edges are covered with the investment, or a little whiting and water can be put over the porcelain if the investment should fail to cover the

Fig. 3.

surfaces properly. When the case is cool all the investment should be removed from under and about the teeth, and the set allowed to stand in sulphuric acid, or be heated for a few seconds in the same. The plate should now be returned to the die on which it was last swaged, where it should fit as accurately as before soldering. The case is now thoroughly washed with water and kept scrupulously clean.

THE MINERAL BODY.

The set is now ready for applying the mineral compound known as "body." A clean sheet of paper should be laid upon the bench on which is placed the work and articles necessary for the process. Enough body is mixed in a porcelain dish with distilled water to serve for the case; a nest of dishes, as used by artists, are convenient, there being four or five circular dishes, each forming a cover for the other. A double-ended spatula, figure 3, is all that is necessary to use for laying on the body and gum enamel, the rounded end is for forming the depressions between the roots in imitation of the natural gum, the smaller and thinner end is used for taking the paste from the dish and packing around and under the teeth and over the plate. The paste should be wet enough to work easily, but not run away from where it is put. A dish of distilled water should also be used in which to dip the spatula when necessary to carry a little water to the body on the plate. Should it be too wet on the plate, a clean linen pocket-handkerchief or napkin is the most suitable for pressing the body and taking up the superfluous water; blotting-paper is not as suitable as linen because the powder adheres to the paper.

The body should be laid over the palate sufficiently thick to prevent the platina showing through after being fired, and on the labial and buccal surfaces according to the thickness required to restore the contour of the face, and to reproduce the natural effect of the gums about the teeth. Jarring the plate will bring the water to the surface, when it can be absorbed by a napkin, and causes a more compact arrangement of the body. When packing on a perforated plate some of the body will pass through the holes to the palatine surface; this must be removed before firing, also any particles that have adhered to the enamel of the teeth; this is best done with a stiffish camel-hair brush, first drying the case over a spirit lamp, not a gas-burner. The case is now ready for the first firing.

FIRING THE BODY.

The set is placed on the nickel slide, as shown in figure 4, usually without any support, but where the body is built over the margins of the platina where it touches the slide the case may be supported with pieces of platina wire or plate.

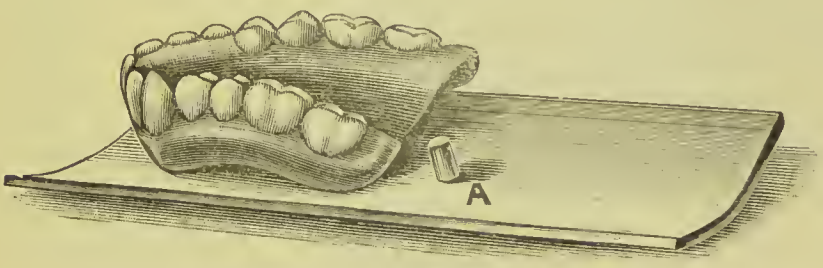

FIG. 4.

At *A* is shown a cylinder of gold foil, those used for filling teeth such as Wolrabs. The melting of this cylinder indicates the fusing point required for the body and gum enamel. By looking into the muffle the cylinder can very clearly be seen to disappear into a minute globule. The first time using the nickel slide it is painted with a mixture of flint powder and water, this forms a coat that effectually prevents adhesion of the melted gold to the nickel. Nothing can be more simple and exact as an indicator than the melting of this cylinder.

A pellet will do as well, such as every dentist has at hand. The globules of gold are not wasted, as they can be put aside for making solder. With this indicator a novice can fire a piece, and this has been considered the most difficult part of continuous gum work. To support the gold cylinder a little wet body is placed on the slide and the gold stuck into it.

THE FURNACE.

Figure 5 shews the furnace. It is supported on a four-legged stand placed upon an iron tray, *H*; it is of fire-clay, bound with iron bands. The principal novel feature in this

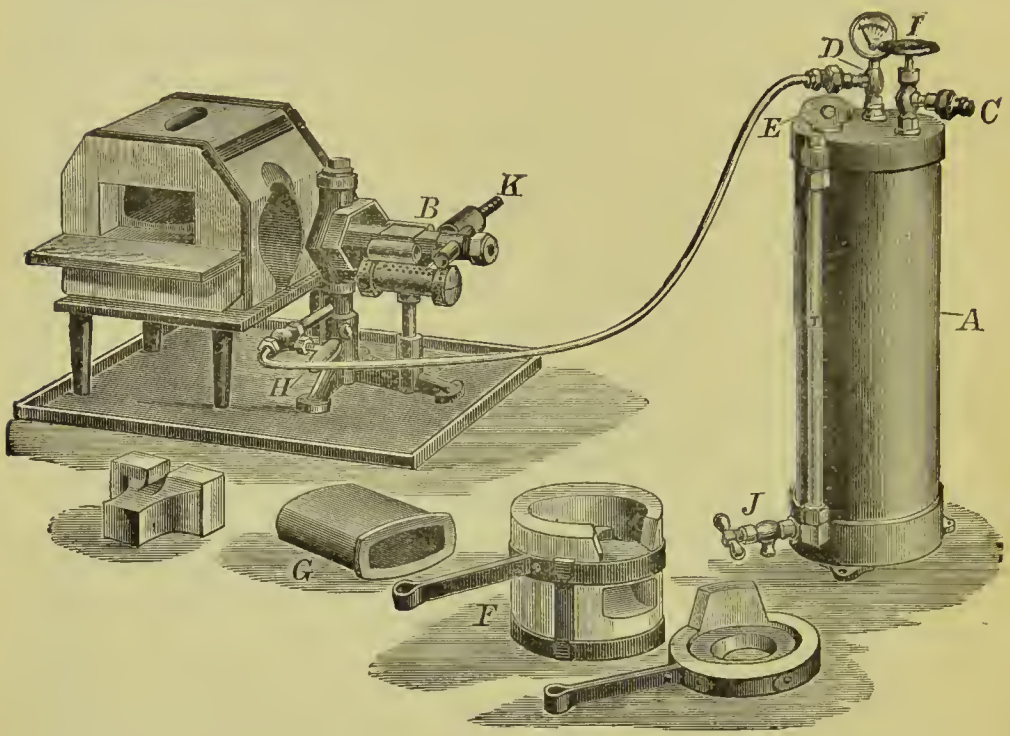

FIG. 5.

furnace is the nickel muffle. It is $5\frac{1}{2}$ inches long by 3 wide, sufficiently large for any case. The great bug-bear in the past to continuous gum workers has been the "gassing" of the case through the fire-clay muffles cracking. When this takes place the body is completely destroyed, and must all be removed from the plate and around the teeth. Porcelain is an extremely sensitive material, the minutest particle of silver

about the plate or in the solder will turn the body yellow, and if a gold coin is used for solder the copper in it will turn the body green. It is consequently necessary to have a muffle that will prevent any impurity from being in contact with the work; platina is the only other metal that will answer, but at 55/- an ounce it is prohibitive for muffles, unless rolled so thin that it is very easily injured by a bit of gold solder or other melted metal touching it; and also the heat reaches the work too quickly for the safety of the porcelain. The furnace is heated by a novel and very effective method of using ordinary petroleum or paraffin-oil, such as is used for lighting purposes in lamps. The oil is poured into the tank *A*, figure 5, by removing the plug *E*, till it is quite full, taking about a gallon to fill it; this is enough to heat the muffle to the melting point of pure gold about ten or twelve times, so that the cost of oil in firing a case three times is about two-pence. The tank of oil is connected to the petroleum-burner, *B*, by a small copper tube, less than a quarter-inch diameter, and may be any length to suit the position of the apparatus when setting it up for working; about two or three feet is generally a convenient length. On the top of the tank is a valve *I*, having a union *C*, to which is soldered a lead pipe for connecting to the town water supply to obtain the pressure necessary to work the burner. The gauge *D* shews the pressure by adjusting the valve *I*. The pressure can be regulated to any point required, up to the highest pressure the town water will give. Water being heavier than oil will be at the bottom or below the oil, pressing it upwards and out through the copper tube. There is a glass tube *T* at the side of the tank to shew the quantity of oil. To the bottom is fitted a valve *J*, which is opened to run off the water when the oil is nearly used up, the plug *E* is unscrewed to do this, and to fill the tank with oil again. To start the petroleum-burner for firing a case there is a Bunsen burner *K* fixed underneath, this is lit to give the petroleum-burner a preliminary heat; it does this in about one to two minutes. The valve *I*, on the tank, is then opened to admit the water,

which forces the oil through the copper tube to the petroleum-burner, and through the hot passages of the burner to two small jets having holes as small as a fine needle, and fixed to a cross tube at the rear end, or the end nearest the tank in figure 5.

In passing through the tubes of the burner the oil is vapourized, and the vapour is projected through the adjustable tubes sliding upon the square tube, and being lit burns with a blue flame, which is thrown through the opening in side of furnace under and around the muffle. The case to be fired should previously have been placed in the muffle on the nickel slide, as shown in figure 4, in order to be heated up with the muffle; about two to five pounds pressure by the gauge is enough to start with for a few minutes, in order to gradually heat the case. The power of the burner is controlled by the pressure of the water on the oil. The gas to Bunsen burner is turned off after the petroleum-burner is started. The sliding tubes should be adjusted on the square tube close to the jets on starting, or till the furnace is hot; the blue flame then plays around the burner as well as in the furnace. It is worked with the sliding tubes in this position for a few minutes, or till the muffle is nearly red-hot. The sliding tubes are then pushed along the square tube away from the jets as far as they will go, when the flame will be thrown entirely into the furnace, and having more air mixed with the vapour will give a more powerful heat. The valve *I* should then be opened wider to produce greater pressure; from 25 to 40 pounds will give sufficient pressure for firing a case, taking about fifteen to twenty minutes from the time of starting. The burner should be placed nearly touching the furnace in starting, and when the furnace gets red-hot withdrawn to about three-quarters of an inch, as the burner gets red-hot also if too close, and is more likely to cause a deposit of carbon in its tubes: this also depends on the quality of the oil; with good oil no deposit seems to take place, but if the oil is not well refined a deposit may occur after using a great number of times. It is then

necessary to unscrew the plugs to the burner and clean out the passages.

If the burner should be used for such purposes as brazing it may be necessary to remove the sliding tubes from the square tube to prevent the flame blowing itself out. A little attention should be given to the adjustment of these sliding tubes till the working is quite understood, as the position of these tubes have a great effect on the blast.

The burner is stopped working by closing the valve, *I*, on tank. If the valve, *J*, is opened the pressure of the water is stopped and the burner ceases working instantly, and by closing this valve again the burner is instantly started, providing the furnace is red-hot or a light is applied to the burner. The fire-clay plug for stopping the mouth of the muffle is better not used till near the end of the firing, as the muffle is ventilated without the stopper in its place.

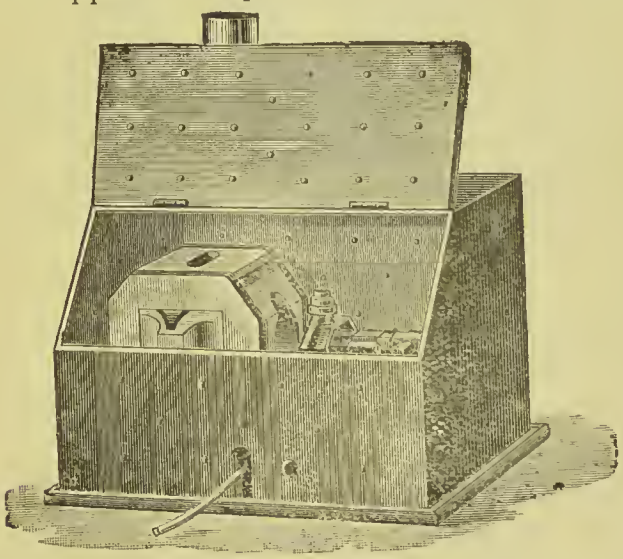

FIG. 6.

Figure 6 shows a hood made of sheet-iron lined with asbestos, for placing over the furnace. The object is to reduce the noise made by the petroleum burner when the noise should be found objectionable. If the furnace is placed in this hood and set up in a fire-place, the noise will be reduced about half, also any smell made by the oil is carried off completely through the hood into the chimney flue.

FIRING WITH A GAS FURNACE.

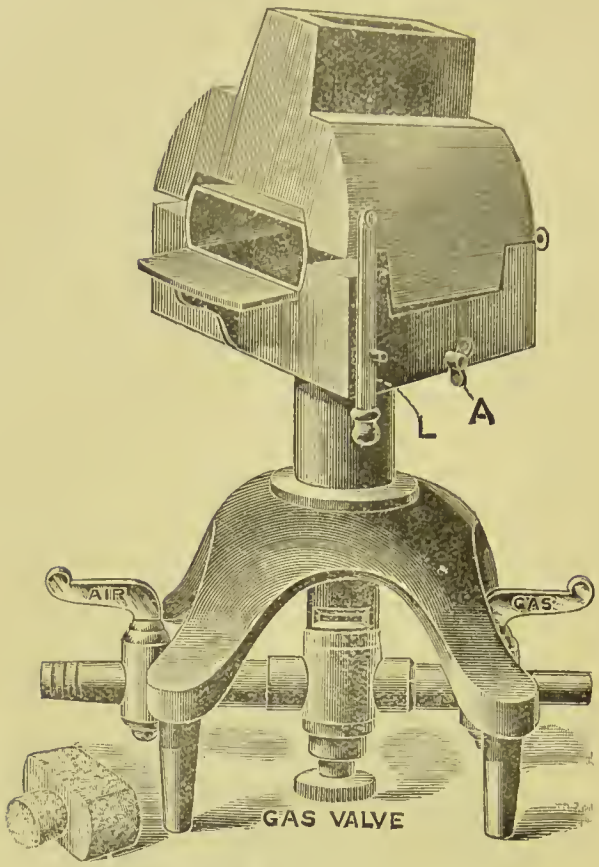

FIG. 7.

The petroleum furnace described has been used successfully for over four years, but since its description has gone through the press it has been superseded for continuous gum work by the gas furnace shown in the above illustration. This has advantages where gas is attainable in the simplicity and convenience of the fuel, the ease, certainty, and rapidity with which a case is fired, that it may be confidently adopted as superior to any other not excepting the electric furnace. The muffle in this gas furnace is also the leading feature as in the petroleum furnace, but it is made from rolled nickel plate instead of being cast, as the fibre and density produced in the metal by rolling gives it a longer life as a muffle. The oxydation of nickel when alloyed with manganese is very slow, enabling one of the muffles to last for firing from 200 to 500

cases, and when it begins to crack it can be quickly replaced with another, as the construction of the furnace admits of the muffle being removed whilst red hot with the work inside and another case proceeded with in another muffle. The size of the muffles are $3\frac{1}{8}$ inches wide inside by $5\frac{5}{8}$ inches long, giving ample room for the largest continuous gum case, or two small cases. The ends of the muffle being clamped between the iron and fire-clay walls of the furnace when closed, the central part only, or about four inches of its length, is acted upon by the blast and raised to the firing heat. After four years' experience in firing several hundred cases with these muffles they can be recommended as superior to platina muffles, which are extremely thin on account of the expense of the material, as platina costs in sovereigns what nickel costs in shillings. An attempt was made some years ago in the Parker-Stoddart furnace, in the United States, to discard a muffle and use a fire-clay or platina dish to support the work, the flame playing directly around the set; this furnace does not seem to have come much into use, probably from the risk of injury to the work, as only an expert can insure perfect combustion of the gas fuel. With a nickel muffle the heat inside is as pure and free from the products of combustion as in the electric furnace, and as a stopper is not used to close the nickel muffle when firing, air has free access to the work—an oxydising heat having been found the best for firing porcelain.

A very useful feature in this gas furnace is the combined Bunsen and blast burner. It is a modification of a type of burner introduced by Mr. Fletcher some years ago, also adopted in the Parker-Stoddart furnace previously mentioned. In the form designed for the furnace shown it is believed to be greatly superior to others, as it is instantly changed from a Bunsen to a blast, or *vice-versa*, the Bunsen being used to dry and gradually and evenly heat up the case before starting the blast, which give a spread and powerful heat very suitable for heating a muffle. The method of giving a preliminary heat to the case by working the burner first as a Bunsen was originated by Mr. Verrier, as in the directions accompanying his furnace is a

description of the manner of working the burner as a Bunsen as well as a blast.

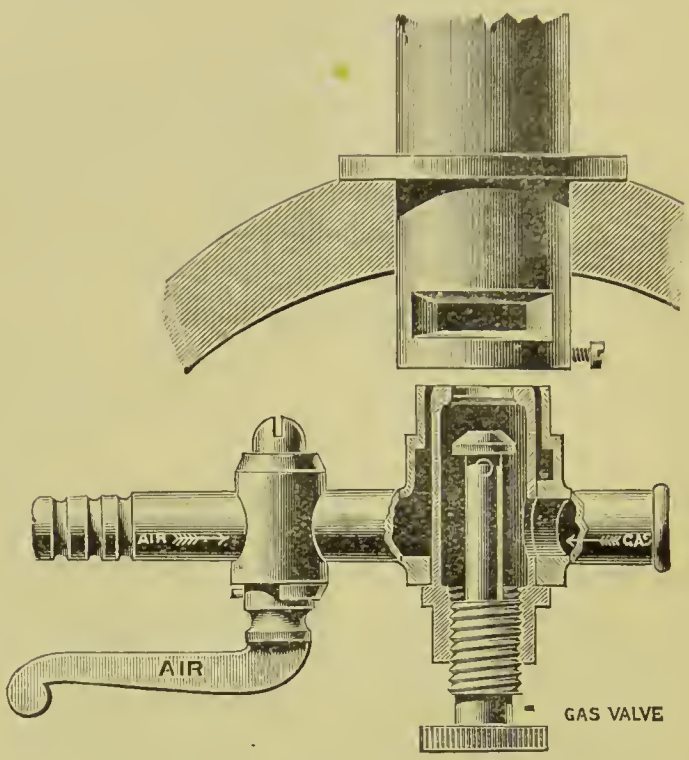

FIG. 8.

The manner of effecting this in the furnace shown in figure 7 will be understood from the sectional engraving in figure 8 of the convertible tap, the gas tube of which is connected to the supply tap with rubber tubing, and the gas in passing through the inner tube is controlled by turning the screw of the gas valve. When the valve is closed a small hole through its centre allows a small supply to pass suitable for a Bunsen flame; by one turn or more to the screw the valve is opened, giving a much larger supply of gas; and by opening the air tap and working the foot blower a blast is produced. The mouth of the burner is fitted with a disk of iron about an inch thick and 2½ inches in diameter, through which is drilled a number of holes with a number 15 twist drill; it will burn as a Bunsen about 25 feet of gas per hour, and as a blast a much greater quantity, according to the heat required. The flame is a broad one, and

is spread all over the bottom and around the muffle so as to heat it equally. The burner works quietly as compared with the burners used in some of the platina muffle furnaces, and does not scream as it would do if fitted with the ordinary gauze or perforated thin plates, used in the ordinary injector form of blow-pipe. To fire a case it is placed in the muffle on a tray made of sheet nickel, in a similar manner to figure 4 on page 13. The upper part of the furnace is opened slightly by the lever *L* catching the pin, as shown in the illustration; this admits air to the burner when working as a Bunsen, and a preliminary heat is given to the work in this manner for about eight or ten minutes; the blast is then started and the furnace closed by releasing the lever *L*: about three minutes' blowing will raise the heat to the fusing point of the body, which is indicated by the melting of the gold cylinder. As the muffle is not closed with the stopper when firing, the fusing of the gold and the body is quite open to inspection, and can be readily seen. The gas is now cut off, and the work allowed to cool down in the furnace; if it is desired to do this slowly, the fire-clay stopper is placed against the mouth of the muffle. A whole set can be fired as described with the greatest ease, certainty, and rapidity, that will be a revelation to old continuous gum workers, and probably to those who are using the electric furnace and taking 45 minutes to fire a single coat, as electric heat must not be urged on account of the risk of fusing the platina wire.

The case is usually left in the muffle to cool about twenty minutes; it may then be taken out and put into hot or boiling water, to which cold water can be added and the case rapidly cooled. The body will not be found to crack and shrink as much as some preparations; all these mineral compounds however shrink more or less, and need a second coat in the great majority of cases, and which produces a more artistic result. Before applying a second coat the case should be tried on the metal die; it will probably be found to require some pressure to get it to its place; a jar will often do this by letting the teeth rest against the palm of the hand, the fingers grasping

the die, then striking the die upon the bench or anvil. If the body should crack around the labial and buccal surfaces it is of no consequence, the second coat will repair anything of the kind. A very perfect method of restoring the fit will be explained when describing a new shot swager. When perforated platina is used the shrinkage in the holes will allow of a little more body being rubbed into them from the palatine side, care being taken to brush off the body from the platina and teeth before firing; a good brush for this purpose can be made of an ordinary stiffish camel-hair by cutting the bristles about half away in a slanting manner to produce a point.

With the object of preventing the contraction of the body disturbing the fit of the plate, the American authorities describe a method of dividing the body into definite blocks, each containing one tooth, as shown in the engraving.

Fig. 9.

The thin end of the spatula is employed previous to the first baking to make the cuts through the body until the spatula touches the plate, and the divisions are continued on the lingual side of the ridge. This method is however unnecessary if a shot swager is at hand. The shrinkage of the body is also liable to check the front teeth in a full set, if the teeth are set and soldered to touch each other; to avoid this narrow strips of card, the thickness of a visiting card, are inserted between the teeth previous to investing and soldering the pins to the plate. The second coat of body is applied where it appears necessary to increase the thickness, also to develope the rougæ and form the festoons around the necks of the teeth. A good effect is produced by forming a slight ridge with the body around the necks, the size of small cord or twine, and fresh body should be placed over the palate in imitation of the

natural rougæ. It requires some practice to do this in an artistic manner, so that the gum enamel will not have a continuous and monotonous shade, but appear lighter over the crests of the rougæ and the roots of the teeth. The firing of the case for the second baking is a repetition of the first, the heat being carried to the same point as indicated by the gold "tell-tale"; it is left in the muffle to cool as already described, and when removed should appear slightly vitrified, or on the point of becoming glossy. For the guidance of those who are novices at this work a piece of fired body is supplied attached to the bottle containing the body; a glance at this will give a clearer idea than any description. After the second firing the case should again be tried on the metal die, and the fit corrected if necessary with the shot swager; but no alteration usually takes place after the first firing.

APPLYING THE GUM ENAMEL.

Before applying the gum enamel the margins where the body joins the platina should be ground smooth with a corundum wheel in the dental engine, so that as little grinding as possible may be necessary after the gum enamel is fired. Distilled water is poured over the case to wet the body, and any defects may be repaired with fresh body. The gum enamel is laid on with the spatula, taking up a little at a time and placing it about the thickness of a sixpence or a threepenny piece. An ordinary quill tooth-pick is useful, when putting on the body and enamel, to clear out between the teeth; this and the spatula are all the instruments required: the brush is used only to free the teeth and platina from the particles of body and enamel. The enamel is better not applied very smoothly—a little unevenness or roughness will be modified in the firing, and look better than a very smooth flat surface. The gum enamel should be placed a little thicker between the teeth, as the natural gum is generally a deeper color in those places; a little light and shade produced in this way gives a much livelier and artistic appearance to the case when finished.

The firing of the gum enamel is also a repetition of the two

previous firings. If time permits it is better to let the case remain in the furnace until cold, and to delay the cooling the fire-clay stopper may be placed against the mouth of the muffle. The platina plate and margins will require to be polished with a cork and brush wheels, using pumice powder and whiting, and finished by gilding with the battery as will be described, which greatly improves its appearance.

If platina tubes have been soldered in position for springs, the swivels are now secured with phosphate of zinc, or a screw may have been tapped in the tube, and a corresponding screw cut on the swivel. Air chambers are not used, but to relieve the plate from rocking a thin layer of wax is placed upon the part of the plaster model corresponding to the boney ridge along the centre of the palate, and the model is scraped on each side of the ridge; towards the back part of the palate, where it is soft and yielding to pressure, gum tragacanth used for a week or two to assist the patient is better than air chambers. Patients should be cautioned not to let the case slip out of their hand when brushing or cleansing them over a stone-ware basin; a napkin placed in the basin or a wooden bowl will prevent an accident of this kind. More accidents are caused to continuous gum work in this way than all others; patients may not admit this, but say it happened whilst eating soft bread and butter, or a bit of sponge cake, or from the jar of walking down stairs.

MAKING PLATES WITH WIRED MARGINS.

The American authorities on continuous gum dentures have different methods of forming a rim around the margins of the platina plate to form a boundary line for the porcelain gum, and also to strengthen the plate. The increased resistance against warping during the subsequent stages of the work make it desirable to adopt a rim of wire around the ridge, and forming a border across the palate, by adding to the plate a combination of wire and an addition of plate, which shall serve as a limiting shoulder to the porcelain, and which may at any time have its form altered so as to increase or diminish the pressure on that portion of the palate.

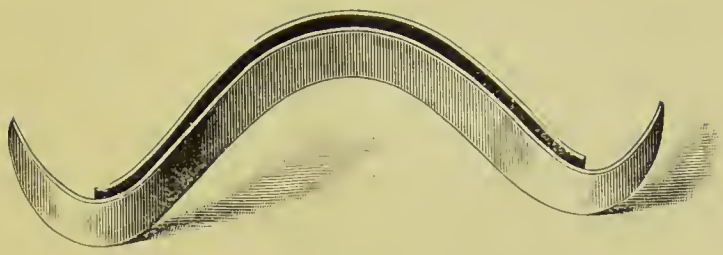

FIG. 10.

Figure 10 is an illustration of the method of forming a border across the posterior margin of the plate. Round platinum wire No. 18 gauge, or the *B* size of the dental depôts, is bent to fit the plate along a line extending from the alveolar ridge of one side to that of the other, and about three-sixteenths of an inch from the posterior edge of the plate. It is first soldered to the centre of the palate with a piece of the gold and platina solder mentioned on page 10. The fitting of the wire and securing it with solder to the plate is then continued across the palate, and over and around the alveolar ridge, until the two ends meet. A piece of thin platina plate, No. 2 gauge, is cut from a pattern wide enough to cover the wire and posterior edge of the plate, and is fitted roughly by bending and burnishing.

A counter die of impression compo is made as described on page 7. The platina plate being on the die, the additional strip is struck in this counter die, and cut away until it half covers the wire, and extends over the edge of the plate; the shot swager may be used for this also. When fitted it is soldered to the wire and plate. A plate strengthened in this manner, and with the wire for attaching the teeth as shown on page 9, offers great resistance to warping during the firing of the body, especially if a solder is used having a melting point above the firing point of the body. This increased strength is of importance also for use in the mouth, as reliance must be mainly upon the platina to stand the stress of mastication.

REPAIRING CONTINUOUS GUM WORK.

When a set has to be repaired after being in use for some

time, it will require to be heated up more carefully than when new. The mucus and fluids of the mouth seem to penetrate into the pores of artificial teeth and continuous gum, and requires to be driven off by heating very slowly, otherwise the gas or steam forming quicker than it can escape, explodes, and pops off a piece of the gum or a tooth. This is the secret in repairing continuous gum, to heat it very slowly. The case is invested in plaster and sand, and heated over a Bunsen burner for about two hours, until it is red hot.

Another way is to boil the set for a minute or two in water, then place it on the nickel slide and insert into the muffle without any investment. Adjust the gas tap so as to give a small flame which can be increased from time to time. To get up a red heat in the set the blast is used.

It is then allowed to cool, the investment removed, and the case well washed in soap suds and pumice powder. If the old body requires to be cut away, or the remaining parts of a broken tooth, a small sharp chisel is the best tool to use, holding it in one hand and giving light blows with a small hammer in the other, the plate being supported on a plaster cast, or, what is better, a fusible metal model which is made upon the plate itself by surrounding it with pipe-clay or an investment of plaster and sand, and pouring in the metal till it covers the highest portion of the palate about a quarter of an inch; this will resist bending the plate during the chiselling better than plaster, and will admit of removing the body all over the palate if necessary without destroying the fit, or if any injury takes place the fit can quickly be restored again by a squeeze in the shot swager.

In the repair of a new tooth the wire attachment may be exposed with the chisel, and the pin or pins of the new tooth bent around it if long enough. Usually a new tooth can be added without soldering the pins—the artificial teeth on each side, and the new body and gum enamel, will fix it securely. One firing will sometimes answer for both the body and enamel by laying on the enamel over the unbaked body, but where much body has to be added there had better be two firings.

If more than one tooth has to be repaired and it appears necessary to solder the pins to the wire attachment or plate, it will be necessary to invest the set in plaster and sand, and heat up the case and solder the pins with the gold and platina solder or pure gold solder in the usual manner. The crucible furnace shown in figure 11 is very convenient for this purpose, as the invested case may be dried and partially heated by the Bunsen flame and completed with the blast.

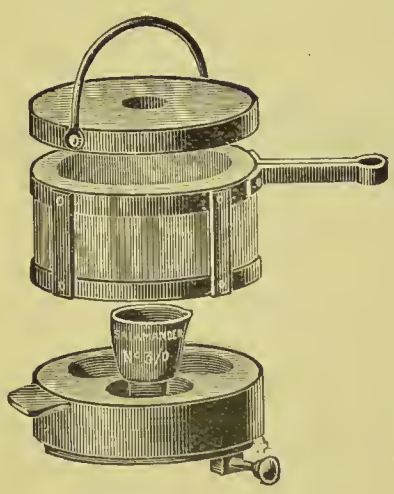

FIG. 11.

The furnace, figure 11, is designed to take the place of the muffle furnace, which, by slacking the nut shown at *A* in figure 7, is readily lifted off the burner and the crucible furnace put in its place. It is used for heating invested work, such as gold plate and continuous gum cases, preparatory to soldering with a blow-pipe ; the burner is first worked as a Bunsen to dry and heat the case, then as a blast ; it will heat up the case for soldering in a quarter of the time required with the usual Bunsen burner. Metals in crucibles may also be melted, such as gold and silver, experimental work in amalgams, etc. The furnace is in three parts :—the bottom on which the work or crucible is placed, a removable centre ring to confine the heat around the invested work or crucible, and the cover. The centre ring is removed when the invested case is ready for soldering with the blow-pipe.

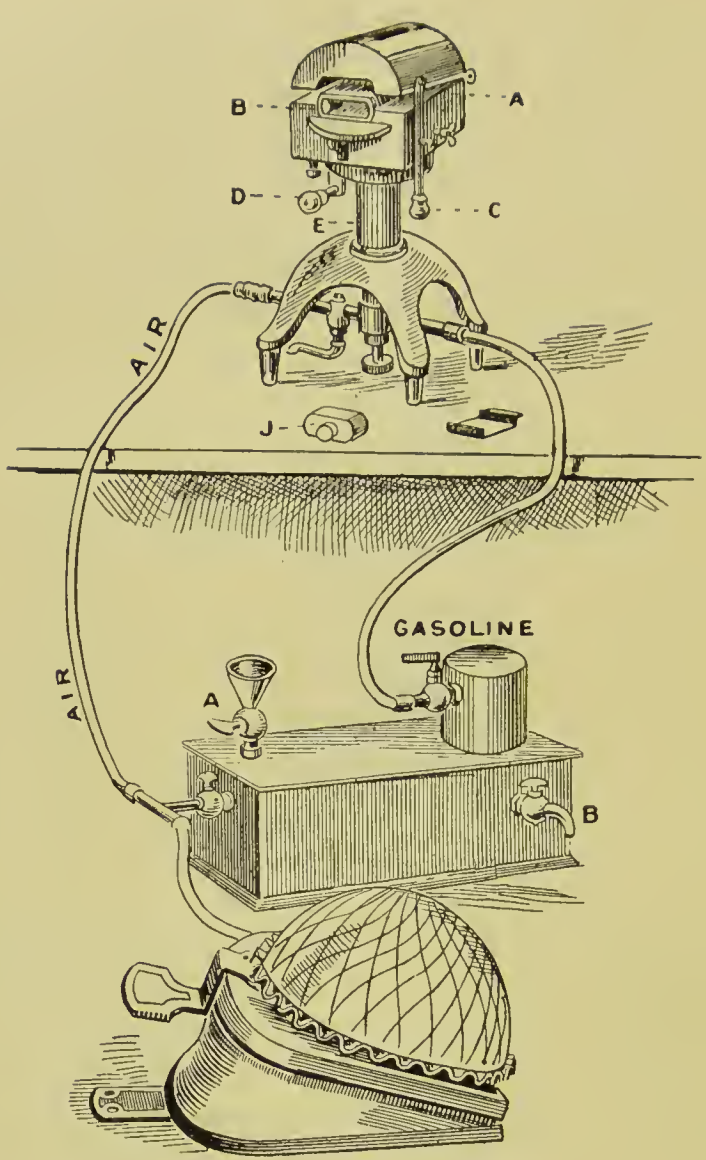

FIG. 12.

Where coal gas is not attainable for heating the muffle and crucible furnaces, gasoline will be found to answer satisfactorily. Figure 12 is an illustration of the arrangement for using it, and shows the generator with furnace and foot-blower complete. The foot-blower shown without legs is the best—it is steadier to work, and it can be seen when the rubber disk is fully inflated.

These very light products of petroleum, such as gasoline and benzoline, are very inflammable, and care must be taken not to

expose them too near a naked light. Another drawback to their use is their disagreeable odour, which is not confined to the room in which it is being used. To obtain perfect combustion the air and gasoline taps have to be adjusted to supply the proper quantities, otherwise the odour is much greater. Ordinary benzoline does not answer well, it is too heavy; a very refined preparation must be used, and this has to be obtained from great centres like London, and the railway companies will not carry it under ordinary conditions.

To avoid these drawbacks the oven part of the furnace, shown in figure 7, is fitted with the automatic blast petroleum apparatus, illustrated and described on page 14. This apparatus will heat the muffle in figure 7 as quickly and effectively as the gas burner, and without any blowing; and as ordinary lamp petroleum is used, such as "Royal Daylight," there is no risk of a fire, as a lighted match may be thrown into an open vessel of this oil, or a red-hot poker stuck into it, without setting it on fire. It is also a cheap fuel, and can be obtained anywhere.

COMPRESSED OXYGEN.

The use of oxygen and coal gas for blow-pipe purposes is coming into use in some trades, and is quite safe; it is impossible for coal gas to get into an oxygen cylinder against the immense pressure. It will be found very useful in dental workrooms, whether continuous gum is done or not. An ordinary gas blow-pipe will readily fuse the gold and platina solder mentioned, but the air pressure required is apt to blow away the solder; the force of an oxygen and coal gas flame is very much less, and at the same time it gives a very much more powerful heat.

Figure 13 shows an improved oxygen blow-pipe for dental purposes. Rubber tube connects the end of blow-pipe with the oxygen cylinder tap, and the tap at the side of the blow-pipe is connected with rubber tube to the gas supply tap. It will solder a crack in a metal plate close to the vulcanite attachment without burning it, and effect a repair in five minutes that sometimes takes as many hours in the ordinary manner. It will also burn out

base metals when melting scraps much more effectively than the usual methods. When using Dr. Hewett's apparatus the oxygen bag can be filled from the workroom cylinder, and avoid encumbering the dental chair with another cylinder for oxygen.

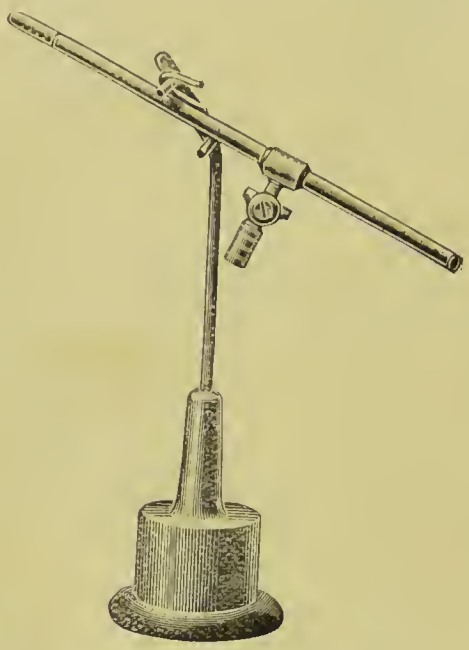

FIG. 13.

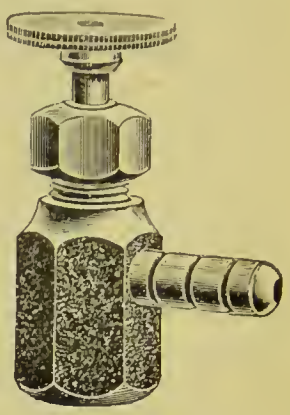

FIG. 14.

Figure 14 shows a fine adjustment valve for the oxygen cylinders; it is convenient to have this valve in addition to the ordinary valve for blow-pipe work. The ordinary valve fitted to the cylinder can be set to deliver the gas at the pressure required; the fine adjustment valve can then be opened and shut instantly to supply the gas always at the same pressure.

The compressed oxygen is supplied in steel cylinders that are tested to a pressure of 3,000 lbs. on the square inch. The following sizes may be had, and are sent out full with fittings complete :—

6 feet	capacity,	size 12 in. by 3½ in.,	in	approximate	weight 8 lbs.	£1	8	0
10 feet	,,	,, 16 in. by 4 in.,	,,	,,	11 lbs.	1	16	0
12 feet	,,	,, 18 in. by 4 in.,	,,	,,	13 lbs.	2	2	6
20 feet	,,	,, 32 in. by 4 in.,	,,	,,	21 lbs.	2	12	0
40 feet	,,	,, 32 in. by 5½ in.,	,,	,,	40 lbs.	3	0	0

The taps of the cylinders should be tested occasionally to see if they leak: this is readily done by pouring a little water around

the valve or holding the tap under water; bubbles will show if there is a leak, which, if not stopped, would imperceptibly empty the cylinder.

PARTIAL SETS.

Partial sets have not been recommended by the writers on continuous gum work, probably for the reason they are under the impression that only pure platina can be used in this work for plate and clasps. The ordinary hard platina, however, with a small percentage of iridium, makes a very good clasp, and will retain its elasticity after the usual three firings of the gum body and enamel. This alloy of hard platina and iridium is better for bands than the alloy of pure platina and iridium. By using hard platina for the plate, and the gold and platina alloy mentioned for soldering the clasps and teeth, a partial case may be made equal to gold in every respect, and will have the advantage of a porcelain enamel for the gum, and will keep its color better than 18 or 20 carat gold; and if the plate is gilded by the battery to be described and illustrated, it will have the appearance of a very rich and artistic piece of work.

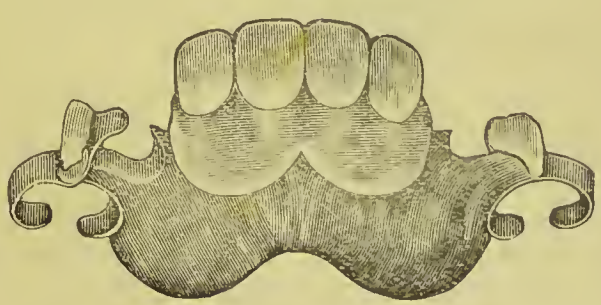

FIG. 15.

Figure 15 is an illustration of a partial set that has been in use in the mouth for years. The palatine surface is not covered with body and enamel, which is confined to the labial surface and around the teeth similar to a case of gold plate with pink vulcanite attachments. Two firings will generally suffice: one each for the body and gum enamel. If it appears necessary to add more body after the first firing, it can be put on under the enamel, and both fired together.

CONTINUOUS GUM BLOCKS AND VULCANITE.

A continuous gum block such as the four front teeth shown in figure 15 may be set in vulcanite. A perforated piece of platina is swaged to fit the model where it is to be covered by the block, and extending over the ridge on to the palate about a quarter of an inch or more; the teeth are then set up and invested with plaster as illustrated in figure 2, page 9. The wire attachment is then soldered to the plate, the case invested, and the pins of the teeth soldered to the wire. It will sometimes be unnecessary to fit the wire attachment provided the pins are long enough when bent to touch the plate. The case is then invested in plaster and sand and the teeth soldered. The body is packed over the labial surface and around the teeth, leaving the pins uncovered for attaching the vulcanite.

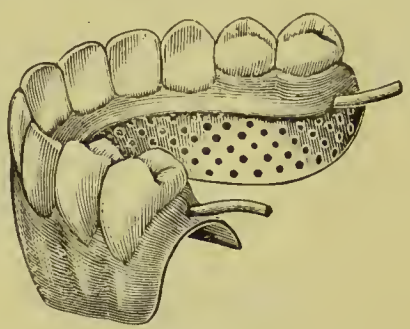

FIG. 16.

Figure 16 illustrates a modification of the method in which the perforated plate is carried further over the palate and left uncovered by the body about a quarter of an inch, in order to unite it to the vulcanite; the wire attachment also projects on each side so as to be imbedded in the vulcanite plate. The block when finished is placed on the plaster model, the molar teeth mounted in wax, and the case treated in the usual manner for vulcanite work. Care should be taken to close the flask with as little force as possible. A weak point in the usual methods of making continuous gum facings, is the risk of cracking the gum enamel in vulcanizing, which may happen from undue pressure in packing the case, but chiefly from the shrinkage of the vulcanite in cooling. This risk is greatly reduced by

carrying the platina over the palate, and making a border of gum body and enamel inside the teeth as shown in figure 16; this forms a girder which prevents the two ends of the block being pulled towards each other by the contraction of the vulcanite.

The great objection to these combination pieces is the necessity of destroying the vulcanite plate in case of a repair to the block; pink rubber may be used, but the block is then a piece of patchwork.

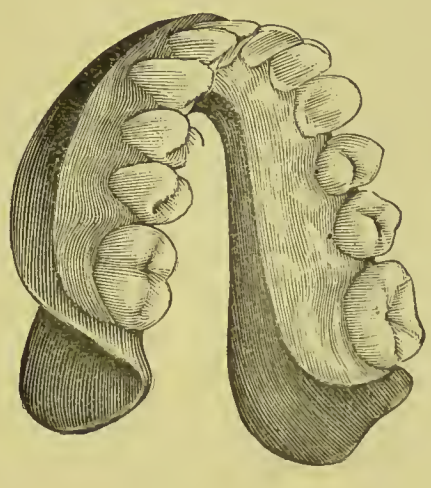

FIG. 17.

The combination of vulcanite and continuous gum is more satisfactory in a case like figure 17 than any other, as lower plates have more frequently to be scraped or cut away to relieve undue pressure, generally caused by absorption of the alveolar ridge on which, unlike the upper, the plate depends entirely for support; for this reason continuous gum work is better adapted for upper cases as a rule than lower. A set like figure 17 is made by moulding a plate of wax or gutta percha over the plaster model. Dies are made upon which a plate of perforated platina is constructed; this is placed upon the gutta percha and the teeth set up. A wire attachment is made and soldered to the plate and pins of the teeth similar to the illustration on page 9, the continuous gum is added, and a vulcanite plate made to take the place of the gutta percha.

TUBE TEETH FOR CONTINUOUS GUM WORK.

The use of tube teeth for continuous gum work is a modification of the process that appears to have been originated by Mr. George Cunningham, of Cambridge. At any rate I find the first description of this method appeared in a paper read by him at the Annual General Meeting of the British Dental Association, held at Exeter, August, 1890, and the demonstrations that were given by him at the same Meeting.

The following is an extract from this paper:—

"For full, but especially for partial dentures, both upper and lower, this new enamel seems to afford a great and important sphere of usefulness for the excellent English tube work. One reason why this work is so little employed is no doubt due to the fact that too frequently the dental mechanic of to-day is lacking either in the ability or in the patience requisite in nicely and accurately adjusting the tube teeth to the plate. This fine fitting of tube teeth, which occupies, even in the hands of an expert, the greater part of the time of manufacture, is entirely obviated by the new method of working it. The plate is struck up in platinum, and, instead of gold, platinum pins are mounted in the usual way, only soldered with pure gold. No fine fitting of the teeth to the plate is necessary, as the body does that more effectually than the most expert manipulator of the corundum wheel. The use of sulphur cement and the working loose of the teeth is also obviated, since they are held firmly in position by the body and the enamel. The general excellence of ordinary tube work is further improved by the filling up of all spaces where food might lodge, while without impairing in any way the utility and strength of the older method, the artistic colouring of the restored gum is, I think, a great advance on the often unsightly long-rooted tube teeth.

"I can confidently recommend, from an experience of quite a number of practical cases in the mouth, this method as being peculiarly applicable to tube teeth mounted on a platinum base, and also feel very certain that if the method were at all generally adopted it would be followed by the introduction of a new and

improved form of tube teeth, which practitioners in this country would at once recognise as being fitly described by the term, diatoric tube teeth. These would have the improved form of the American counter-sunk teeth and the solidity of the English tooth-body without the unnecessary platinum tube. For our purpose such teeth wonld be immensely superior to the flat ordinary teeth, if only from their having that rotundity of outline which is characteristic of the natural teeth."

Mr. William Simms, of Manchester, who has had much experience with continuous gum work, has also recently adopted tube teeth for this process, and has sent me the following description of his methods :—

"For continuous gum work there are no teeth more satisfactory than 'tubes,' both for front and back teeth. One great advantage they have over every form of pin tooth is that there is no necessity for investing the teeth to solder them to the platinum plate. They are also less liable to fracture in the mouth, and, in case of an accident—a very rare occurrence, are more easily repaired. In the construction of plate for this work, Nos. 4 and 5 hard platinum plate is used. When the plate is stamped it should be reduced to the size it is intended to occupy in the mouth. As continuous gum is necessarily brittle and liable to chip, it is better that the body and enamel should not be brought to the extreme edge of the plate on the buccal and labial aspects. At this stage therefore, soft platinum wire, about the thickness of iron binding wire, is soldered to the plate one-eighth of an inch from its edge with platinized gold solder. When this wire has been tacked in several places, it is better to paint along the edge which is to be next to the continuous gum with whiting, to prevent the solder running on that side. A free amount of solder is flown on the other side of the case gradually to the extreme edge of the plate. By this means a strong edge of metal protects the body from chipping, and affords also a satisfactory means of reducing the plate if this is found to be necessary, as it not unfrequently is. The treatment of the palatal side of the plate will depend upon whether the artificial gum is to cover the whole of the palate, or only to extend just

beyond the palatal aspects of the teeth. In the first case the platinum wire will be soldered one-eighth of an inch from the edge of the plate on the palatal side, and may be completed at the same time as the wire is soldered round the front of the plate; in the second case the soldering of the wire had better be deferred until the teeth are all fitted, so that the position of the wire may be accurately determined. If the matter of weight is one of consideration, it is best to refrain from covering the palate with gum.

"To the ordinary mechanic familiar with tube work no difficulty presents itself in the use of tube teeth for gum work. The teeth are to be roughly fitted to the plate in the ordinary manner. Fine fitting is not necessary, nor indeed is it essential that the teeth should touch the plate at all, although it is better that they should do so. In the majority of cases they will inevitably touch the plate, as most of the cases which demand continuous gum are cases of somewhat prominent gums, and where therefore there is no great space between the teeth and plate. Where the teeth are fitted somewhat to the plate, there is also less liability for the teeth to twist round the platinum pin in the furnace.

"The position of the teeth having been arranged with due regard to esthetic appearance, etc., the position of each hole in the tooth is indicated in the plate, and corresponding holes drilled therein. (It is probably better to fit the teeth and solder the pins one at a time, in order to secure greater accuracy.) Hard platinum pins of length equal to the length of the teeth are soldered to the plate with platinized gold solder by means of the oxygen blow pipe (figure 13), using oxygen and coal gas, or N_2O and coal gas.

"The plate being thoroughly cleansed should be roughened where the gum is to cover it, and the teeth are replaced over the the pins. Each platinum pin should be roughened or nicked by means of a graver, so that the teeth are tightly held on to each pin. This is to prevent the teeth turning, or altering in position during firing. The subsequent processes are the same as for other kinds of teeth. The beauty of the finished set is greatly

increased by gilding after thoroughly smoothing and polishing, and this is readily done by means of an ordinary bichromate battery.

"The tube teeth at present in the market are susceptible of great improvement. At present there is too little variety in shape, size, and colour, but it is hoped that in the near future we may witness greater enterprise in our manufactures in this respect.

"The tube teeth made recently by Messrs. Ash & Co. for crown work are not unsuitable for this work if a greater choice were afforded.

"Tube teeth, originally made before the introduction of vulcanite for gold work, are too square and too wide at the necks for gum work. The fault of the tube teeth of Messrs. Ash is that they do not afford sufficient room at their necks for gum. Their virtue for gold work is their disadvantage for gum work. They can however be greatly improved in this respect by judicious cutting on the lathe by means of carborundum stones, for by careful grinding and shaping the necks of the six front teeth can be very quickly indicated, and room made for gum to take its natural place between the teeth."

From the foregoing descriptions the advantages of tube teeth appear to be their strength as compared with pin teeth, and in case of a fracture of a tooth the ease of repair, as no soldering is required, the body and enamel being sufficient to secure the new tooth upon its platina post. The method is doubtless limited to suitable cases, as the posts cannot be set in any position, or in the position that may be sometimes desirable. Also the platina wire carried around the ridge, as shown in figure 4, not only serves for attaching the teeth, but adds greatly to the strength of the case; whereas the same wire used as posts for tube teeth obviously does not do so. As English tube teeth have a lower fusing point than American teeth, it will not be practicable to use American continuous gum body, but the body and enamel previously described will be quite suitable. Perforated platina may be used if desired. In this case the plate will be made as described on pages 24 and 25, and the

body and gum enamel must be laid on to cover all parts of the exposed perforated platina. It gives the set a more finished and artistic appearance to cover the palate with the gum enamel, as well as increasing the strength.

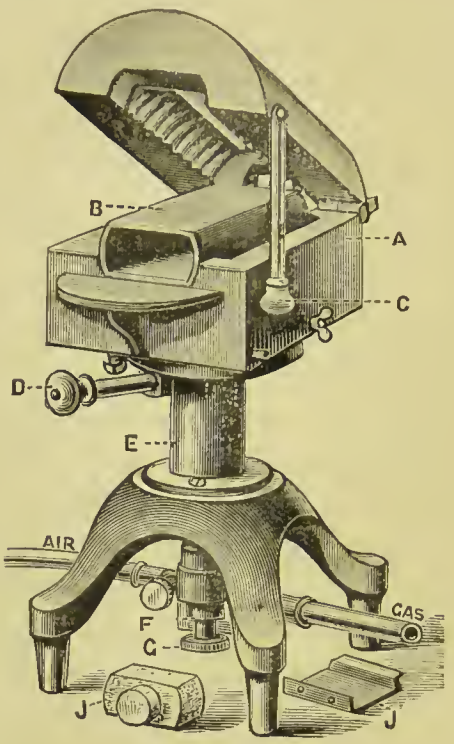

FIG. 18.

CROWN AND BRIDGE FURNACE.

If the operator wishes to restrict his operations in porcelain to crowns and bridges or blocks, the furnace shown in figure 18 will be found very satisfactory; the leading features in which are the same as in the larger, figured on page 18. It is fitted with a nickel muffle, $1\frac{3}{4}$ inches wide by 4 long. The portion of the muffle actually heated to the fusing point of the body and gum enamel is $1\frac{3}{4}$ inches by 2 inches, enabling a good size piece of work to be dealt with, such as the partial set shown on page 31. The muffle is made from rolled metal, 21 B. W. gauge, and is strong and thick enough to prevent the heat reaching too rapidly the porcelain teeth. They are shaped to bring the heat close to the work on the top, and are reversible, the top

becoming the bottom, thereby lengthening the life of the muffle. When a minute crack appears it can be closed by hammering, or filled with wet fire-clay; also, as the expense is but little compared to platina, a new one may be kept at hand to replace the old one. As the melting point of nickel or of this alloy is about 3,000° Fah., the muffle cannot be melted, the gas supply and the foot blower not being sufficiently powerful. The furnace is fitted with a smaller size of the combined Bunsen and blast burner, illustrated and described on page 20.

ARTIFICIAL CROWNS.

All the varieties of crowns have posts that may be divided into two types; the Logan and its modifications are one type, the round post including the screw is the other. In England the latter type is represented by Ash's tube tooth crown, the recently introduced Newland Pedley screw crown, the Balkwill and Lennox crowns. Doubtless of all the crowns introduced the Logan is the one most extensively used, and after so many years' trial it must be admitted that it is a case of the survival of the fittest. Round posts, including all forms of them, have two great defects; they are very weak as compared with the Logan post on the line requiring the greatest resistance, which runs from the lingual to the labial surfaces. The roots themselves and their nerve canals plainly indicate the shape a post ought to be; this is especially the case with the canine, which has to do the hardest work.

FIGS. 19 AND 20.

FIGS. 21 AND 22.

The face of an average size upper canine root is shown in figures 19 and 20, which are prints from sections of natural roots. The longest diameter across the face drawn through the centre of the canal in a medium size tooth will be about five-sixteenths of an inch, and the shortest diameter about three-sixteenths. Figures 21 and 22 are prints from lower canine

roots, in which the difference between these measurements are still greater. Therefore the root indicates that the section of a post in the greater diameter should be nearly double that through the lesser, or in the proportion of three to five.

FIG. 23.

FIG. 24.

Figure 23 is an enlarged diagram of the Logan post. It will be seen that its section nearly approaches these measurements, but not so perfectly as the post shown full-size in figure 24, which is thicker at the centre than the Logan, and thinner at the edges where the Logan is flanged. This flange is, I think, a mistake, as it necessitates cutting away more of the root than is required. The defects in the Logan post are that it is thick where it ought to be thin, and thin were it ought to be thick.

But notwithstanding these defects its principle is correct, and accounts for its success. The other defect in round posts is the little resistance they offer to turning; this force in mastication has a great effect in loosening round posts unless special precautions are taken by shaping or banding the root. These precautions are quite unnecessary with the posts figure 24. The canals, as shown in figures 19 and 20, are reamed out to the shape of the posts, and it is therefore impossible for the post to revolve in the slightest degree. This resistance against bending and twisting prevents the lingual joint being opened and the cement washed out, and together with the long bearing the post has in the root, renders the trouble of fitting a band quite unnecessary; after nine years' experience I have seen no necessity for bands for front teeth. The reason there are so many varieties of round posts is doubtless owing to the ease a nerve canal is enlarged with a drill and fitted with a wire or screw. If the designers of these round posts had the control of the laws of evolution, they would doubtless have ordered the roots of teeth to be grown round like tapered pegs turned out in a lathe. A Buttner crown with its round peg and round band could then be fitted to a

charm, and round tapered holes in the alveolus could then be made for round tapered roots with the greatest ease and nicety. As round roots are not likely to be grown in the future any more than in the past, it only remains to make a post of a section in harmony with a section of the root. This reasoning has led to the adoption of the modified form of Logan crown now to be described.

MODIFIED LOGAN CROWN.

The post is shown in figure 24, and an ordinary pin tooth is used. The advantages are—(1) the post is as strong or stronger than the Logan, and does not require so much of the tooth substance removed to receive it; (2) an ordinary pin tooth is used instead of having to keep a large stock of the Logan; (3) the crown and post are very strong, as the post is soldered to the pins instead of being baked into the base of the crown, and the strength is reinforced by the crown body which is baked to the lingual surface to the shape of the natural tooth. This is readily done now in such a furnace as figure 18; when the Logan crown was introduced these crown furnaces were unknown.

The illustrations, figures 25 and 26, represent a porcelain crown which may be either of the front teeth; the same description will answer equally well for any of the six front teeth of either jaw; the bicuspids and molars require a different treatment. The root is prepared by grinding after excision to a level with the gum, or slightly below towards the labial surface. A Morey drill is then run up the canal as far as it will go, taking care to do this with a pumping action, so as not to force any septic matter through the foramen. A reamer, figure 27, is now used to shape and enlarge the canal to suit the post shown in figure 24, and fitted to the root in figure 28. In doing this the root is cut away on the lingual side more than the labial, as it is desirable to have the post as far on that side as possible, so as not to be ground away too much when fitting the tooth. The post should pass into the root as far as possible, or as far as a root filling would usually be made; the longer the bearing of

the post in the root the less likelihood of splitting the root in use, For convenience of handling, the posts are punched out long enough to project about three-sixteenths or a quarter of an inch from the free end of the root. As the weakest part of the root is across its shortest diameter, it will be noticed that this is not cut away so as to make it weaker, but that the reaming is done along the longest diameter from the lingual to the labial surface; thus the root is not weakened, and the post is very strong in the direction of the greatest strain, the natural teeth supporting the crown in the other direction.

FIG. 25.

FIG. 26.

FIG. 27.

FIG. 28.

FIG. 30.

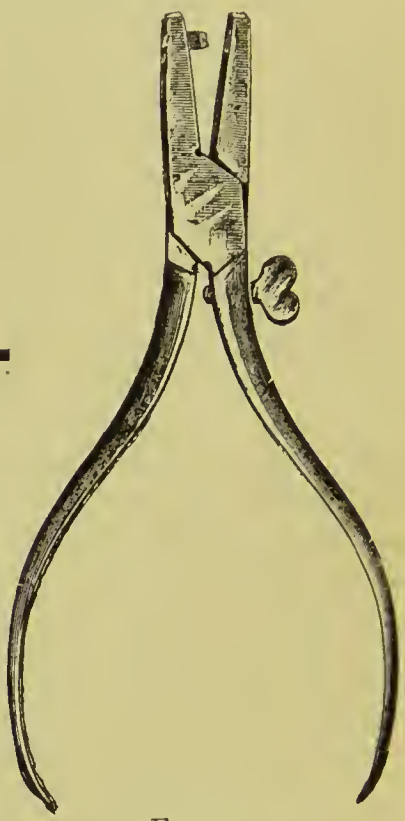

FIG. 29.

If more than one of the posts are being fitted at the same time it will be advisable to file notches in the projecting ends to indicate the root they are fitted to, and their position in the roots; this will save confusion. A cap of thin platina is now fitted to the face of the root by punching a slot in it with the punch, figure 29. By adjusting the screw of punch these slots

are made to differ in size as shown in figure 30, so that the post may be pushed through to its proper position in the root. A blunt plugger or an automatic mallet is next used to fit the cap to the face of root and to grip the post, which is removed and soldered to the cap with pure gold. It is then replaced in the root and the fitting of the cap to root completed; a band may also be fitted to the root if desired, but from a long experience I think this is unnecessary.

An impression is next taken with plaster, embracing two or three teeth on each side. The post usually comes away with the impression, if not, it must be removed and carefully placed in the impression, and a plaster model made. An ordinary pin tooth is fitted to suit the case, the end of the post being cut to fit between the pins which are bent to touch it, then cemented together, removed from the model, invested, and soldered with fine gold. The crown will now appear as shown in figure 25, and, after pickling in acid and cleaned perfectly, the crown body is applied as represented in figure 26, and fired in the furnace. On account of the shrinkage a second coat of body will usually be necessary, and its color should harmonize with the tooth; about six shades will answer for nearly all cases. They are conveniently put up in small bottles like the engraving. [FIG. 31.

Gum enamel is useful occasionally to lay on the neck of a tooth that is too long to look well. The crown will usually require smoothing a little around the joint of the body and platina with a corundum wheel in the dental engine. To attach it to the root the post is heated with a spirit lamp hot enough for Gilbert's G. P. Stopping to stick, then pressed into the root, removed again, and the surplus G. P. cut away; it is then smeared with phosphate of zinc, and pressed firmly to its position. To prevent any of the phosphate being forced through the foramen, it may be previously filled with G. P. The post is removable for repairs by grasping the broken crown with hot pliers. For some time past I have been experimenting with a

much cheaper post than iridio-platinum; it is an alloy of nickel 90 parts, platinum 10; this makes a very strong post which can be soldered with pure gold, and does not discolor the body in firing. I get it specially prepared by the nickel smelters who succeed in making the alloy by melting it in a Cornish crucible placed inside of another crucible, pouring into an ingot mould, and rolling in the flatting mills to No. 13 of the plate gauge. The posts are then punched out to the shape shown in figure 24.

APPARATUS FOR GILDING.

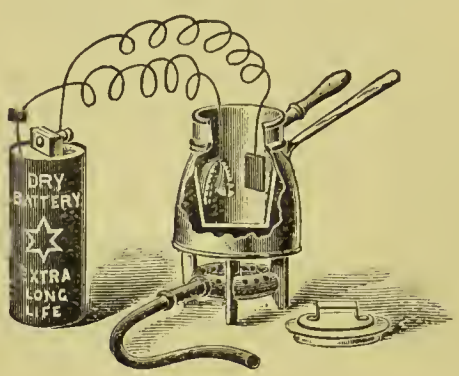

FIG 32.

Figure 32 represents a gilding apparatus which will commend itself for its simplicity and effectiveness, and the little trouble to prepare for gilding and keeping in order. The principal feature is the use of a dry battery, as it is not so troublesome as a wet one, is always ready, and will last for years.

They have been used by the Atlantic Cable Co. in this neighbourhood for the last three years, and the operators say they would not return to wet batteries again on any account. Another feature that saves trouble for gilding on a small scale is the easy manner of preparing the gilding bath. A porcelain cup is made to fit into a heating pan containing water like a glue pot. The cup is also nearly filled with a pint of distilled water; into the water is put one ounce of cyanide of potassium of the highest commercial quality; the solution is made hot by the gas burner heating the water in the pan. The article to be gilded is suspended by the insulated copper wire connected to the negative pole of the battery, as shown in the engraving. A pure gold anode is suspended by a piece of platina wire soldered to it;

this is connected to the positive pole by another piece of insulated copper wire. On dropping the article and the gold anode into the bath the action commences, and in ten to fifteen minutes there will be enough gold dissolved into the solution to begin depositing on the work. After the solution is prepared in this way, a minute or two will suffice to deposit a rich coat of gold, which will only require brushing with soap and water, or lightly polished with a circular brush wheel and whiting, the plate, previously to gilding, having been well cleaned and polished, as the deposit will not adhere to a soiled surface.

The solution must always be made warm or hot before use, and *care must be taken* not to let the anode *touch* the article, or the ends of the copper wire come into contact, as a short circuit will be set up which will exhaust the battery in a few minutes.

The color of the deposited metal can be varied in several ways. It can be darkened by (1) increase of temperature in the solution; (2) increase of battery power by using two cells instead of one, "in multiple arc," that is to say the positive pole of the one is connected to the positive pole of the other, and the same with the negative poles; (3) increase of free cyanide; (4) decreasing the distance between the article and the anode. Water should be added from time to time to replenish loss from evaporation, and cyanide sufficient to keep the anode bright, which should be removed from the solution when not in use.

To have a small gilding apparatus at hand is useful in many ways in a dental workroom. Gold plate work is improved where solder is exposed and liable to tarnish. Continuous gum plates look more attractive, and the gilding not being exposed to wear on the palatine surface will last a long time. Patients do not appreciate the color of platina as it looks like silver, and prefer the gold appearance although they are told the plate is gilded.

SWAGING WITH SHOT.

The engravings, figures 33 and 34, represent a new apparatus for swaging with shot, and is used for several operations, some of them not having been attempted before to my knowledge.

The idea of using shot was originated in the United States for making contour crowns and completing the swaging of metal plates by hammering; but this is a crude operation, and quite unsuited for some of the objects accomplished in the apparatus figs. 33 and 34. The several methods for which the apparatus is suitable are :—

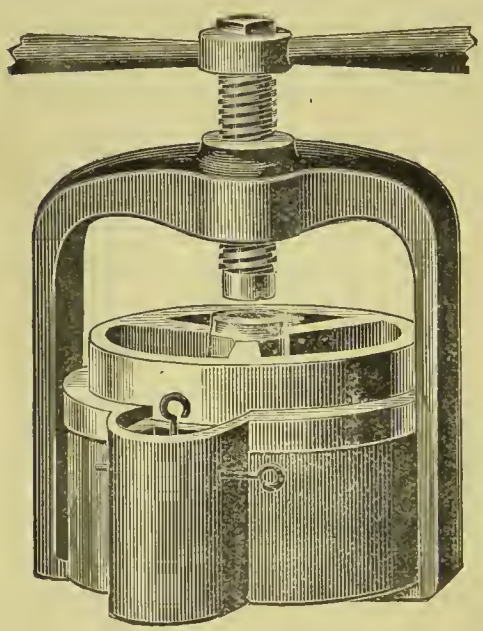

Fig. 33.

(1) To swage a continuous gum plate to fit the model at any stage of its construction, enabling the fit of the plate to be retained on the die until the work is finished ready for the patient's mouth, thus overcoming one of the greatest drawbacks in making continuous gum work.

(2) To swage a bad fitting vulcanite set to fit a correct plaster model, and at the same time close the spaces that usually exist caused by shrinkage of the vulcanite from the teeth.

(3) To swage a sheet-tin lining into an impression, so that the tin becomes the working surface of the plaster model for moulding vulcanite.

(4) To swage trial base plates in tin for taking the bite and mounting the teeth.

(5) To swage polishing plates for the lingual surfaces of plaster moulds so that the vulcanite is cooked between polished tin surfaces.

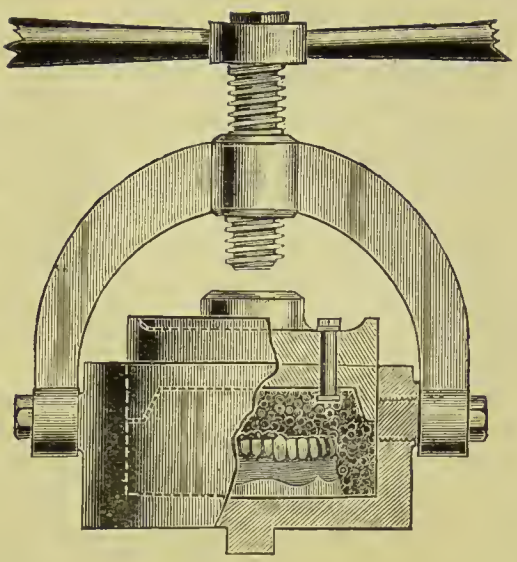

FIG. 34.

(6) To complete the swaging of gold or metal plates to a plaster or fusible metal model, producing a better fit than by dies alone.

The apparatus consists of a strong cylinder, about four inches in diameter, having a solid bottom cast in "Delta metal," a patented alloy similar to gun metal; this is turned in a lathe to receive a turned plunger of the same material. An iron clamp or stirrup is made to receive them, and the clamp is fitted with a screw operated by a double-ended lever about 18 inches in length, which is used to drive down the plunger with great power upon the shot. To secure the clamp from turning with the screw it is gripped by the cross plate at the bottom in a vice, or between two pieces of wood screwed upon the work-bench. The smallest shot made, No. 12, are generally the most suitable, but are not kept in stock at ironmongers' shops; No. 10 is, and this size will be suitable, and cost 3*d*. per lb. Small steel balls, $\frac{1}{8}$-inch, as used for bicycles, have been tried, and work with less friction, but are much more expensive than gun shot, even those that are cast aside as defective in their manufacture.

A rubber disk, about a quarter of an inch thick, and in diameter the size of the plunger, is also required in some of the

operations. The idea of interposing a rubber disk in stamping plates was, I believe, originated by Dr. Telshow, of Berlin.

The methods for attaining the different results will now be described.

SWAGING A CONTINUOUS GUM SET.

For making a continuous gum set a thin model is cast in the die metal mentioned on page 6. This metal is now supplied by the dental depôts in round blocks similar to the illustration figure 35.

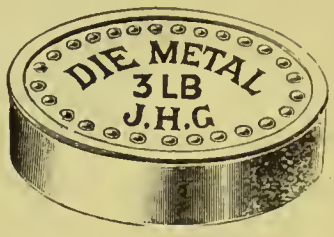

FIG. 35.

A thickness of about a quarter to three-eighths of an inch over the palatal arch will be sufficient. The piece of platina to form the plate may be roughly fitted to the model with a horn mallet, or the model is placed on the bottom of the cylinder as shown in figure 36, and the platina placed upon the alveolar ridge in its proper position. Upon the platina plate is dropped the rubber disk, and over this is poured the shot about an inch in depth. The screw is now operated to drive down the plunger upon the shot to partially swage the plate, which is then removed from the swager and annealed. The swaging is repeated until the plate is sufficiently adapted to prevent the shot getting between the plate and the model; the rubber disk is then removed, and shot only used to complete the swaging. The screw pressure is sufficient to effect this with a No. 4 gauge perforated or non-perforated platina plate. During the swaging the plate may have to be slit, and soldered at points around the ridge, in the usual manner, to prevent folding.

The next stage of the construction in which swaging is likely to be required is after the margins and posterior border of the plate are wired, and the wire attachment for the teeth soldered on the plate, similar to the plate shown on the model in figure

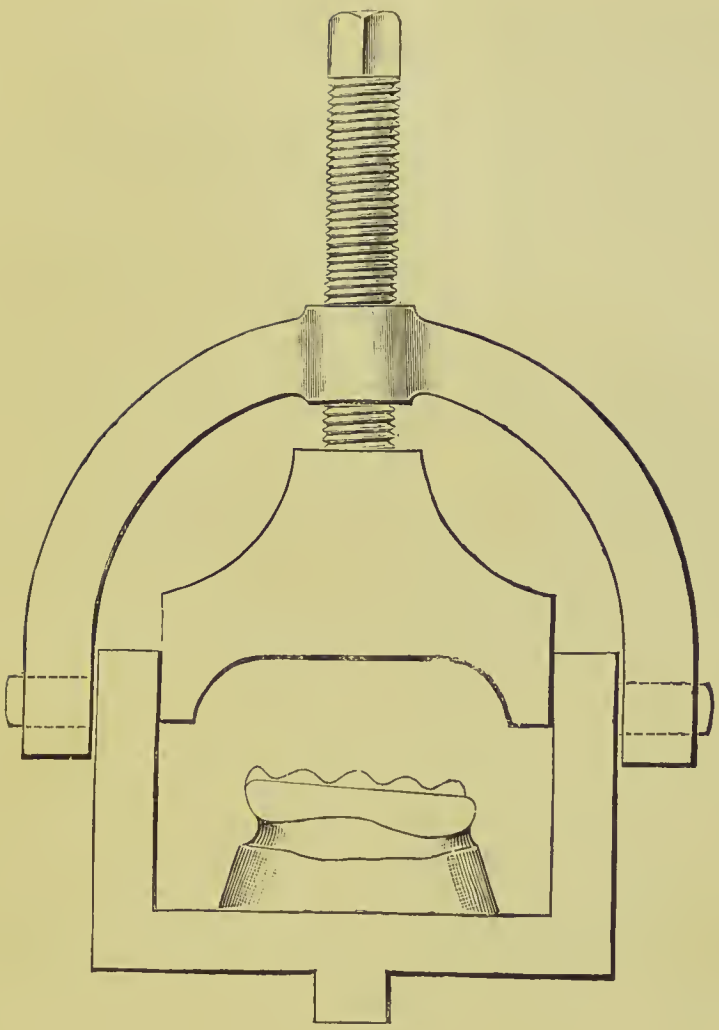

FIG. 36.

36. During the fitting and soldering of these wires the plate is liable to be sprung or warped so as to rock on the model; the fit is immediately restored by placing the model and plate in the swager as in figure 36, pouring in shot until they cover the plate about half an inch in depth, and operating the screw to force the plunger upon the shot. It is obvious that the plate must be swaged as well with the wire attachments on the plate as off, and that the wires will not be distorted or bent in any way.

The next stage in which swaging is nearly always required is after firing the first coat of body; on trying the set on the model it will generally be found that the fit is injured, caused by the

shrinkage of the body, as all these mineral bodies contract in firing more or less.

To restore the fit, press the set to its position on the model as near as possible with the hands, then place in the swager as shown in figure 34, pour in the shot and operate the lever to screw down the plunger with as much power as an average man can apply. It is better to leave the pressure upon the set for a few minutes. On removing, if enough pressure has been put on, the fit will be perfectly restored and without injury to the teeth. This may seem somewhat incredible to anyone who has not seen the operation performed. It is, however, obvious that the shot distributes the pressure evenly in every direction, similar to water under pressure, and this accounts for the teeth not being injured. To be able to refit the plate in this easy and perfect manner is invaluable in continuous gum work. The set should be tried on the model again after the second firing, and again swaged if necessary.

SWAGING A VULCANITE SET.

Vulcanite sets may frequently be improved in their fit by swaging. The plate may not fit well over the palate, or the rim over the buccal and labial surfaces may not sit close on these surfaces; sometimes new plates do not fit owing to an imperfect model, or to the shrinkage of the vulcanite in cooling, as the softened plaster model offers but little resistance to this contraction.

An impression of the mouth is taken, and a plaster model made, upon which the set is placed and pressed to its position as closely as possible. They are then put into the swager as shown in figure 34, and the shot poured in as described for swaging a continuous gum set. The plunger is screwed down until a slight pressure is produced upon the set. The apparatus is then placed in a pan of boiling water, and when this temperature has reached the vulcanite set it will be sufficiently softened for swaging. This is done by placing the swager again in the vice and operating the screw in the same manner as for swaging a continuous gum set, but the pressure required for vulcanite is not so great as for continuous gum. The apparatus is next transferred to a

vessel of cold water, and when cold the set is removed. Small dents will be impressed by the shot all over the plate and rim, but are easily removed with fine sand paper and brush wheels.

Should the plate around the margins not fit the model sufficiently to prevent the No. 12 shot getting between the plate and model, then a larger size shot should be used, and, if necessary, the No. 12 to finish the swaging.

Everyone who has removed the teeth from a vulcanite plate that has been worn for some time will have noticed that there are usually hollow spaces between the vulcanite and the lingual surfaces of the necks of the teeth, due to the contraction of the vulcanite, and which become crevices for holding the debris deposited from the fluids of the mouth. The effect of swaging is to obliterate these spaces and improve the sanitary condition of the set.

LINING IMPRESSIONS WITH SHEET TIN.

The idea of lining impressions with tin is not new, but it has not been done with shot swaging before to my knowledge. The object is to obtain a plaster model with a tin surface upon which to vulcanize. To accomplish this it is better in most cases to take two impressions: one to be lined with sheet tin about No. 2 gauge, the other for making a thin plaster model, on which is swaged the tin preparatory for lining the impression. The method of swaging the tin to the model is similar to that described for platina plate, but the tin is swaged much more quickly and easily. It is next removed from the model and placed in the impression to complete the swaging. The object of swaging first on the model is to spare the impression from the rougher part of the process. In an impression of a shallow mouth and ridge the tin may be swaged into the impression direct, but it is better to prepare the lining on the model in the great majority of cases. The impression to be lined is better taken in plaster. A shallow brass cup turned to fit loosely in the swager is nearly filled with plaster. The tray containing the impression is pressed into it, the handle passing through a slot in the side of the cup. When the plaster has set it is trimmed, and will appear like the engraving, figure 37.

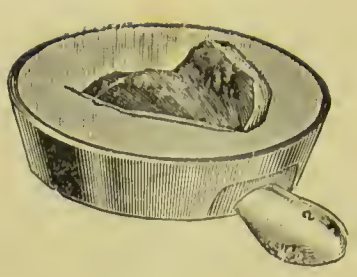

FIG. 37.

The cup is next placed in the swager, which has a recess on one side (figure 33) for receiving the handle of the impression tray. A plug held by a pin closes this recess against escape of the shot. The tin lining being in the impression is next covered with the rubber disk, upon which is poured the shot, and the final swaging effected by turning the screw upon the plunger with considerable force; this is quickly done, when the cup is removed, and the impression filled with plaster for a model. The tin will come away with the model and form its working surface.

SWAGING TRIAL BASE PLATES.

These plates are quickly made, and besides obtaining a rigid plate for taking the bite, they are very useful for mounting the teeth, and forming the pattern plate in vulcanite work, as they faithfully reproduce the rougæ and the contour of the mouth, and ensure an even thickness of the vulcanite. In these respects they have distinct advantages over trial bite plates made of fusible metal or of vulcanite. These tin plates can be swaged to fit the model so accurately, and the rougæ and other peculiarities reproduced so distinctly, that a second plaster model may be cast from them for testing the fit of the plate after it is vulcanized, as the contraction of the vulcanite may have injured the fit and necessitate swaging the set as previously described. The plates are swaged from sheet tin, or its alloys, No. 7 gauge; a double plate of this gauge will give the right mould for the palate of a vulcanite set, but three thicknesses may be employed if greater strength in the vulcanite is required. They are swaged upon the plaster model as described for preparing tin linings for impressions. In making a double plate the one

next the model may extend over the ridge the full size of the proposed vulcanite plate; the other may be cut to extend over the palate to the top of the ridge; the wax for taking the bite and mounting the teeth will hold them together. If the decision is to cast a plaster model from the swaged plate, a No. 2 gauge plate is made first, and then two thicknesses of No. 7 gauge to fit upon it, as the thinner plate gives the most accurate copy of the model.

POLISHING PLATES FOR LINGUAL SURFACES.

These plates are easily made, and the advantages of treating the rubber between polished tin surfaces are obvious. The denture produced is of an even thickness, greater density and strength, more elastic, and on stripping the tin plates from the vulcanite a fine polished surface on both sides is disclosed, and will have a superior appearance, especially if combined with continuous gum work. The polish left from the tin on the palatine surface is more tolerant to a sensitive mouth, and not so liable to produce "rubber sore mouth."

After the teeth are mounted, and the wax around the ridge carved and smoothed to the desired shape of the vulcanite, a thin plaster model is made of the lingual surface of the palate, extending to the cutting edges and grinding surfaces of the teeth. When set the model is removed, and a No. 2 tin plate swaged upon it in a similar manner to the trial base plate described. The plate is transferred to the set, and when flasked will be securely embedded in the mould, and form a polished tin surface for its lingual side. When vulcanized, the tin is readily stripped off the plate.

SWAGING GOLD PLATES.

The apparatus will be found useful in completing the swaging of gold plates, and in undercut models will avoid the necessity of making cores for moulding. A thin plaster model is made in the usual manner, or, what is better, a fusible metal model is cast direct into a plaster impression. A wall of pipe-clay or impression compo is formed around the impression for casting a model a quarter of an inch thick over the palatal arch; this is

removed from the impression, moulded in sand, and a die and lead counter cast. If there are undercuts in the model they may be filled in with a little wax sufficient to prevent dragging when withdrawing the model from the sand. The die is best made of the metal mentioned on page 6, using the Pearsall moulding flask, which does not appear to be adopted so generally as its merits deserve. It seems unaccountable that members of the profession who wish to do the best work should continue to use the old-fashioned rings for moulding, and thermometers instead of gas regulating gauges for their vulcanizers. One of these Pearsall shaped dies is sufficient to strike up the plate, which is then placed upon the fusible metal die and given a final swage in the shot swager, using shot only without the rubber disk. If the screw pressure is not powerful enough to complete the swaging, the cylinder and plunger can be removed from the clamp and placed on a flat solid surface, such as an anvil, and the central projection of the plunger struck heavy blows with a lead mallet or counter die. An iron hammer would batter the bearing for the end of the screw. The method can, with advantage, be employed to reswage an ill-fitting plate with the teeth on or off, and on a plaster model as well as a metal one. If the model does not sit flat and true upon the bottom of the swager, shot can be placed underneath to give the model an even bearing, when it will not be distorted owing to the even distribution of the pressure.

There are other uses to which this apparatus may be applied, such as the swaging of gold contour crowns, but the details have not been yet sufficiently worked out to give a reliable description.

FUSIBLE METAL.

The following fusible metal alloy will be found suitable for casting models from plaster impressions:—lead 2, tin 3, bismuth 6.

This alloy will melt in a ladle placed in boiling water, and should be stirred with a piece of wood before pouring. A wall of Stent's or similar compo is moulded around the impression which should be damp with cold water. If there are no undercuts the model may be removed without injuring the impression,

and another cast. Other fusible alloys have been tried, but with them the face of the models are apt to be porous. The above alloy will be supplied by the manufacturers of the swaging apparatus.

CONCLUSION.

Objections are raised against continuous gum work that it cannot be repaired in a satisfactory manner. This objection has no doubt arisen through heating up too quickly, cracking and bursting the gum as previously described. It can however be repaired so that the addition cannot be detected, and this can hardly be said of any other work. The weight is another objection that appears to trouble those who have had no experience with continuous gum work, but, if the plate fits well, patients do not complain, and made with perforated platina the weight is but little if at all greater than with other materials.

Another objection is the clinking noise made by a full upper and lower set. This seems to be a real objection to start with, but patients soon learn to manage them so that the clinking is not observed. It is an objection to other materials also.

The readers of this little book who are also acquainted with the American methods will probably arrive at the conclusion that the procedure described is practically a new departure in continuous gum work, and that there is very little taken from Dr. Allen's methods but the name. It is therefore necessary in arriving at a decision as to the practical success of the processes described, to discard any prejudices that may have been formed against continuous gum work made by the American methods and apparatus; I agree with the advice as regards these methods, to leave them severely alone. A few, who may probably be counted on the fingers of one's hand, are successful, but the work has evidently been too complicated and uncertain to be adopted by the many.

It is believed that these drawbacks are now overcome, that the processes, apparatus, and furnaces described place continuous gum work within reach of any gold plate worker, and that porcelain work is the most promising field of any for plates,

crowns, and bridges. The latest appliance for this process introduced from the United States is the electric furnace; I have tried this and seen it worked by others, and am compelled to look upon it in its present condition as a scientific toy. Electricity has possibly a future before it for dental purposes, but for heating a continuous gum furnace it will have to be improved very considerably before it can compete with the gas furnace shown on page 18. Besides other drawbacks the fact that it takes over forty minutes to fire a coat of body, whilst the gas furnace will do the work better (because quicker) in ten, is enough to show its present disadvantages.

The reason porcelain dentures have not been generally adopted are no doubt the following :—

(1) The troublesome furnaces, and risk of "gassing" caused by the use of fire-clay muffles, which was the crux upon which chiefly depended the success of continuous gum work.

(2) The use of pure platina exclusively for the plate, practically restricting the construction to full sets.

It would be about as reasonable to use pure gold instead of 18 or 20 carat gold for plates, as pure platinum is nearly as soft as pure gold.

(3) The troublesome manner of fitting the platina attachments for the teeth.

(4) The use of pure gold solder, the melting point being lower than the fusing of the body, the teeth being in consequence liable to shift their position when the body fuses.

(5) The want of an exact and simple indicator, such as the melting of a gold cylinder, as a guide for the firing.

(6) Preparing "the body" for firing at the melting point of pure gold.

(7) The want of good elastic bands such as the alloy of hard platinum (platinum and copper) with iridium.

(8) The want of a simple and certain method, like the use of the shot swager, to preserve the fit of the plate on the die till the work is finished ready for the patient's mouth.

BEARE AND SON, PRINTERS, PENZANCE.